RADIO AND TV

focus

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Radio and Television in the United States

The average family in the United States listens to the radio for about two-and-a-half hours a day and watches television for more than three-and-a-half. How much of this time it is giving undivided attention to the program is, of course, debatable, but in any case the total of over six hours is striking evidence of the role these mass media of communications play in our lives.

On repeated occasions during the last few years the public has been shocked by obviously unethical behaviour on the part of entertainers, producers, sponsors, and others, and has clamored for governmental action, or private censorship, or fundamental reforms of some sort, yet little or nothing has been done to enforce the laws and codes that ostensibly govern the broadcasting industry.

Even the most basic fact about these mass media has been largely ignored, that is that a radio or television broadcaster receives free of charge a publicly owned channel (which, incidentally, may be a source of astronomical profits), in exchange for which it is his responsibility to use this channel in the best interests of the people. A nation's "air waves" are a valuable treasure; and they are a limited resource which should be used as carefully as farm land, forests, water power, or mineral wealth —for the benefit of the nation.

As everyone knows, a radio or television station broadcasts programs from a single point into a limited zone around this point. To do this, it uses certain electromagnetic "waves." These waves cannot be compared to waves in water—the physicists describe the spectrum as rays (waves) or as particles (photons), or both together. However, it is convenient here to use the term "waves." The wave length is the distance between the crests of two waves; the frequency of a wave is the number of waves (wave lengths) which pass a certain point in a second, or the number of cycles per second. Two stations of a given power using the same wave length must be at a given distance from each other or their programs will be unclear. In other words, there are spatial limitations to the number of stations that can operate effectively at the same frequency.

On the other hand, although in theory electromagnetic waves range in size from extremely large to extremely small, there are limits to their practical use for broadcasting. At the lower end of the spectrum the wave lengths get bigger and bigger (observe the spacing of stations on your radio dial), becoming more and more awkward to use and more difficult to detect. In the other direction, they become smaller and smaller. The principal difficulty

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here is that small waves travel in straight lines but are not reflected by upper layers of the atmosphere as are the larger waves; and much more energy is needed to send a very short wave signal a given distance.

Most of the spectrum is quite unsuitable for communications use. Radio and television size waves should be large enough so that they can get around houses and hills. Radar size waves are valuable for exactly the opposite quality: they are smaller than hills, houses, planes, and ships, and are reflected by them and can thus be used for detecting such objects.

Electromagnetic waves travel at the speed of light —186,000 miles a second. A current oscillating in a wire 60 times a second produces an electromagnetic wave which has a frequency of 60 cycles a second. The length of the wave will be 186,000/60, or 3,100 miles long, which is of little value for communications because the signal is too difficult to detect or differentiate. The accompanying table indicates the present uses of the electromagnetic spectrum, and shows how limited are the waves now available for radio and television.

RADIO. The possibility of radio communication was discovered during the nineteenth century, when various British, French, Italian, German, American, Russian, and Indian experimenters demonstrated that an electric current in a wire produces a magnetic field around the wire. As the current increases, the magnetic field grows and induces a current to flow in another separate wire. Thus an electric current or signal is created at a distance. A strong alternating current induced in a wire (aerial) may be detected without amplification in a crystal set radio. An alternating current with its rising and falling power must be used; a direct continuous current and its magnetic field do not induce other currents. The crystal, or radio tube or transistor, makes an intelligible message out of the alternating current by acting as a valve which lets current through in one direction but not in the other. If the resulting one-way (rectified) current is weak, it must then be amplified by a different kind of radio tube or transistor until it is powerful enough to activate a telegraph key, earphones, or a loudspeaker.

When you change your radio from one station to another, you change from one wave length to another. Actually, one radio station uses quite a group of wave lengths, because music and the human voice use different wave lengths for high and low notes. A station is therefore licensed to use 10,000 wave lengths, a band or channel 10 kilocycles wide. On the whole radio dial (540 to 1,600 kc.) there is room for 106 stations. Each station has a monopoly of that part of the dial, and no other may use these wave lengths unless it is far enough away not to interfere. Cities are allotted up to 10 or more stations each, depending on their size and the spectrum space available in that part of the world.

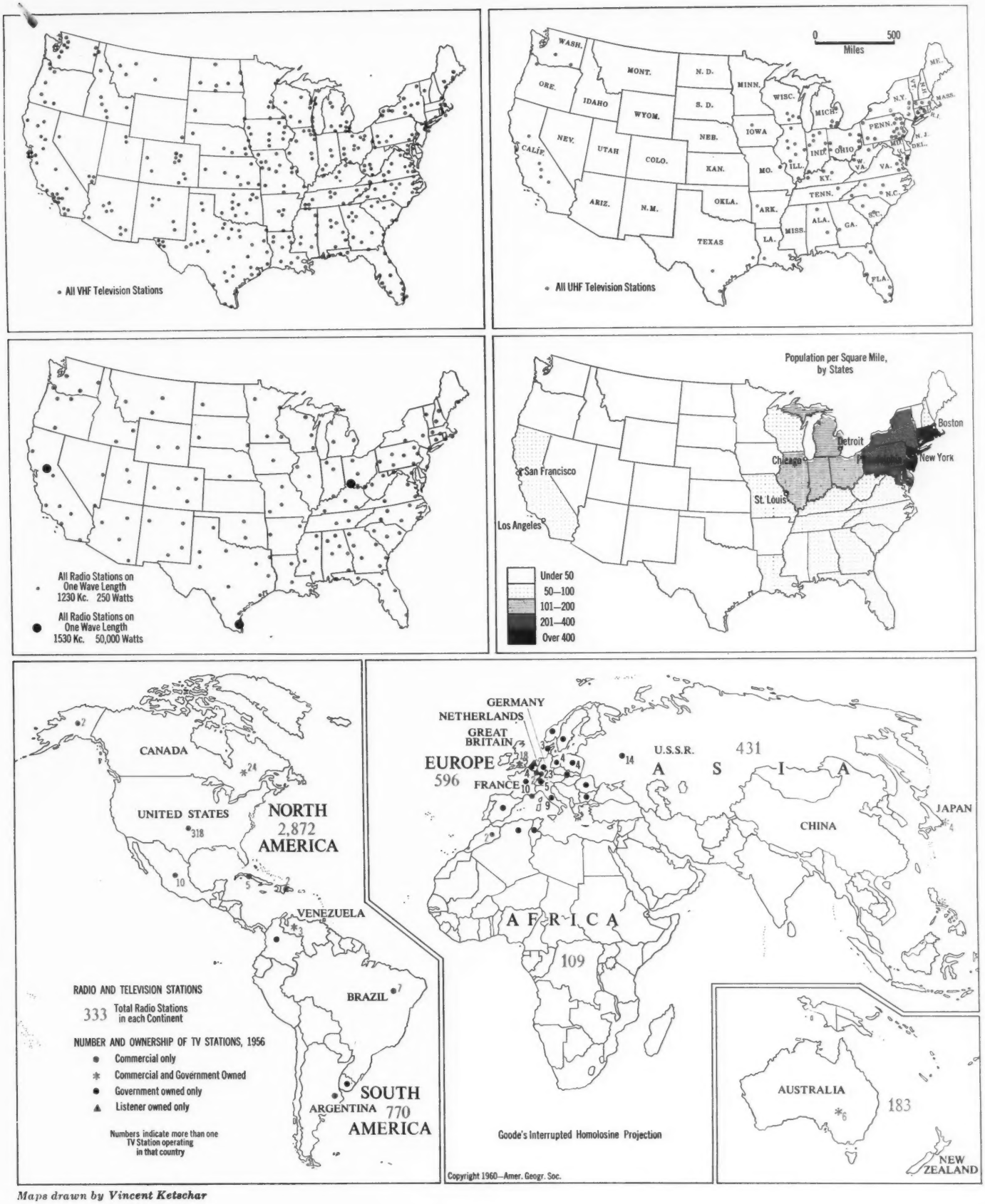
Competition for space on the air waves obviously is most intense in areas of dense population, and during the evening hours when a large part of the public is at home. Certain wave lengths have been assigned, by the Federal Communications Commission, which regulates such matters in the United States, to a few high-powered 50,000-watt stations. Other wave lengths are used for moderately powered stations; and still others for low powered ones, of 250 watts. Since their signals do not travel as far, many more medium powered and low powered stations are allowed to operate on the same wave length. As things now stand, there is not much room for expansion of broadcast radio in the United States.

Europe, too, has nearly reached the saturation point, but on the other continents there could be quite a few more radio stations. Australia and New Zealand, for instance, have enough money and spectrum space available for several more, both commercial and governmental.

TELEVISION. A television station takes up much more room in the spectrum than a radio station, because it must transmit pictures as well as sound. In American television a maximum of 350,000 dif-

USES OF ELECTROMAGNETIC SPECTRUM

	Waves Used
Radio	1,800 to 500 feet long
Police, amateur, industry, navigation, military, radio-telephone, short wave FM radio, VHF television	500 to 2 ft. long
UHF television	2 to 1 ft. long
Radar and diathermy	3 inches to 1 in. long
Infra-red radiation from the sun	0.1 in. to 0.0007 in. long
Visible light	0.0007 in. to 0.0001 in. long



Maps drawn by Vincent Ketschar

ferent wave lengths may be needed to transmit a single picture. There are 30 pictures each second. Hence the maximum number of wave lengths needed is 10.5 million, as compared with 10,000 for a radio station. In actual practice, a television station is not allowed a band or channel of 10.5 million wave lengths. It has to make do with a channel 5 or 6 million wave lengths wide, to leave room for other stations. After the North American system was set up it was decided that there was not enough room for channel 1, so it has never been used. Most stations are on the twelve channels numbered 2 to 13, which are called VHF or Very High Frequency television. Channels 2 to 6 use wave lengths which have between 55 and 88 megacycles, or million cycles, per second, and channels 7 to 13 divide up the space from 175 to 216 megacycles per second.

In the larger cities all twelve of the VHF channels may be used, but in the sparsely settled areas there may be no more than one or two in use. More stations could be built in the high plains and mountain states if there were a larger or a richer audience there. In parts of the midwest, and in the east and south the density of such TV stations is more or less uniform; it does not vary with the population density. The reason is that here the VHF stations are at their maximum density, and no more could be operated without interfering with the existing ones.

As for rates charged, they increase, of course, with the size and wealth of a station's audience. They are lower in Arizona, for instance, where the average VHF station has fewer than 100,000 viewers, than in New Jersey, where it has 4.8 million.

There are other channels above number 13, using smaller wave lengths, which are called UHF or Ultra High Frequency channels. They use wave lengths which have between 470 and 890 megacycles per second. Many of these are still unused. They are not popular with broadcasters because such short waves, as noted, are reflected by buildings and hills, they do not travel as far as VHF wave lengths for a station of a given power, and most TV receivers are not equipped to pick them up. In a few places the public has bought or converted enough receivers to give a station an audience comparable in size to that of a VHF station, but most such stations reach so few people that advertisers are loath to buy time. Some have gone bankrupt, others keep operating with difficulty.

A few of these channels are used for educational purposes, and more probably will be used in the future. The Ford Foundation and a group of leading educators have announced, for example, an interesting new experiment in educational television. The classes will be conducted by teachers selected after a nationwide search for talent, and will be recorded at Purdue University, in Lafayette, Ind. They will then be broadcast from a DC-7 airplane flying in a tight circle over Fort Wayne, Ind. at an altitude of about 25,000 feet. It is estimated that these educational programs can be picked up in 13,000 schools and colleges within a circle 400 miles in diameter, bringing to them classes of higher quality than they would be able individually to provide.

The UHF stations occur generally only where the VHF channels are completely filled up and the population density is high, as in the north central and northeastern states. In spite of their disadvantages, more of these stations can be built if the demand for them increases, whereas in these areas no more VHF ones can operate because there is no more room in the electromagnetic spectrum.

Outside of the United States there is as yet no such competition in the television field. In Great Britain, France, Germany, and the Soviet Union stations are rapidly being built, and the major cities are or will be served. Great Britain and the Six

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Common Market countries have connecting television links, and such links will also be built in most of the Soviet Union during their current seven-year plan. Most Latin American and Asian countries (including mainland China) are in the process of creating isolated TV stations, but they are primarily concerned now with establishing more radio broadcasting stations.

COSTS AND PROFITS. In the United States the costs of operating a television station are met by selling advertising time. In France and several other countries the government pays for preparing, presenting, and broadcasting programs, and still others have both commercial and government stations. The accompanying map shows how television programs are paid for in various countries. The Netherlands has perhaps the most unusual system, in that listeners control the program directly.

Commercially operated television stations in the United States, now numbering 318 (as compared with 29 in 1948!), try to present programs which will attract the greatest number of people. Most everyone is familiar with the system of program ratings which is used so extensively to determine what will be broadcast. Advertisers like this system because they want to reach the largest possible number of viewers. The broadcasting charge for an hour's television network program in the evening may amount to $80,000, plus an additional similar charge for acting and production. Large manufacturers with national markets for frequently used consumer goods are best able to afford such programs. High rentals for time on the air are a measure of the extent to which a station has a monopoly of the electromagnetic resource in that locality. Since profits for an average TV station have been rising steadily and rapidly and now amount to well over $200,000 a year, it would appear that lack of spectrum space rather than lack of return on invested capital limits the number of VHF television stations.

Compared with the swelling television industry, radio has not done so well. The number of AM stations rose from 1,762 (1948) to 2,774 (1955), but profits declined from 48 per cent a year to 29 per cent. The rapidly increasing number of stations has not been due to the discovery of a way of overcom-

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